

We claim:

1. An automatic power control system for automatic power control of a semiconductor optical amplifier arranged to amplify a signal, the system comprising:

an optical power detector arranged to detect the output power of the semiconductor optical amplifier;

means for deriving a measure of the drive current of the semiconductor optical amplifier; and

an automatic power control loop arranged to provide automatic power control of the power of the amplified signal for maintaining the power of the amplified signal in the output from the semiconductor optical amplifier at a desired level using both the detected output power of the semiconductor optical amplifier and the derived measure of the drive current.

2. An automatic power control system according to claim 1, wherein the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier.

3. An automatic power control system according to claim 2, wherein

the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on at least the derived measure of the drive current.

4. An automatic power control system according to claim 3, wherein the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on the derived measure of the drive current and the detected output power.

5. An automatic power control system according to claim 3, wherein the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on the derived measure of the drive current and the desired level of the amplified signal.

6. An automatic power control system according to claim 1, wherein the automatic power control loop further comprises memory means storing characteristics of the semiconductor optical amplifier, the automatic power control loop using the stored characteristics to compensate for the estimated level of

amplified spontaneous emission in the output power of the semiconductor optical amplifier.

7. An automatic power control system according to claim 6, wherein the memory means stores a look-up table of the characteristics.

8. An automatic power control system according to claim 6, wherein the memory means stores a numerical formula representing the characteristics.

9. An automatic power control system according to claim 1, wherein the automatic power control loop is arranged to derive an estimated level of the amplified signal from the detected output power, compensating for the level of amplified spontaneous emission in the output power of the semiconductor optical amplifier, and to provide said automatic power control using the estimated level of the amplified signal.

10. An automatic power control system according to claim 9, wherein the automatic power control loop is arranged to derive the error between the estimated level of the amplified signal and the desired level of the amplified signal, and to provide said automatic power control using said error.

11. An automatic power control system according to claim 1, wherein the automatic power control loop comprises:

an analog feedback loop arranged to perform power control of the semiconductor optical amplifier using the detected output power as a feedback signal to maintain the output power of the semiconductor optical amplifier at a selectable level; and

a controller arranged to control said selectable level, compensating for an estimated level of amplified spontaneous emission using at least the derived measure of the drive current, so that the power of the amplified signal is maintained at the desired level by the analog feedback loop.

12. An automatic power control system according to claim 11, wherein the controller is arranged to implement a control algorithm comprising:

estimating the level of the amplified signal in the output power of the semiconductor optical amplifier using the derived measure of the drive current and a measure of the output power;

calculating the error between the estimated level of the amplified signal and the desired level; and

using said error to control said selectable level.

13. An automatic power control system according to claim 12, wherein

said measure of the output power used in said step in said control algorithm of estimating the level of the amplified signal is said detected output power used by the analog feedback loop.

14. An automatic power control system according to claim 1, wherein the automatic power control loop comprises a digital controller arranged to provide said automatic power control of the semiconductor optical amplifier using both the detected output power and the derived measure of the drive current.

15. An automatic power control system according to claim 14, wherein the controller is arranged to implement a control algorithm comprising:

estimating the level of the amplified signal in the output power of the semiconductor optical amplifier using the detected output power and the derived measure of the drive current;

calculating the error between the estimated level of the amplified signal and the desired level; and

using said error to perform said power control.

16. An automatic power control system according to claim 15, wherein said step in said control algorithm of estimating the level of the amplified signal in the output power of the semiconductor optical amplifier comprises:

estimating the level of amplified spontaneous emission in the output power of said semiconductor optical amplifier; and

subtracting the estimated level of amplified spontaneous emission from the detected output power to derive the estimated level of the amplified signal in the output power of the semiconductor optical amplifier.

17. An automatic power control system according to claim 16, wherein said step in said control algorithm of estimating the level of amplified spontaneous emission in the output power of said semiconductor optical amplifier is performed using the derived measure of the drive current and the desired level of the amplified signal.

18. An automatic power control system according to claim 1, wherein the optical power detector is a photodetector arranged to receive a portion of the output of the semiconductor optical amplifier.

19. An automatic power control system according to claim 1, wherein the means for deriving a measure of the drive current of the semiconductor optical amplifier is a current detector arranged to detect the drive current of the semiconductor optical amplifier.

20. An automatic power control system according to claim 1, wherein the automatic power control loop includes a current driver arranged to supply said drive current, the automatic power control loop being arranged to control the current driver to perform said power control.

21. An automatic power controller according to claim 20, wherein:  
the automatic power control loop is arranged to control the current driver to perform said power control by way of supplying a control signal to the current driver representative of the drive current; and  
the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier using the detected output power and the control signal supplied to the current driver as the derived measure of the drive current.

22. An automatic power control system according to claim 1, wherein the controller further comprises means for outputting monitor signals representing at least one of:

the output power of the semiconductor optical amplifier;  
the estimated level of the amplified signal; and  
the estimated level of the amplified spontaneous emission in the output power of the semiconductor optical amplifier.

23. An automatic power control system for automatic power control of a semiconductor optical amplifier arranged to amplify a signal, the system comprising:

an optical power detector arranged to detect the output power of the semiconductor optical amplifier; and

an automatic power control loop arranged to provide automatic power control of the power of the amplified signal for maintaining the power of the amplified signal in the output from the semiconductor optical amplifier at a variable, desired level using the detected output power of the semiconductor optical amplifier, wherein the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on at least two variables.

24. An automatic power control system according to claim 23, wherein the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on the detected output power and the desired level of the amplified signal.

25. An automatic power controller according to claim 23, wherein



the automatic power control loop includes a current driver arranged to supply said drive current, the automatic power control loop being arranged to control the current driver to perform said power control by way of supplying a control signal to the current driver representative of the drive current; and

the automatic power control loop is arranged to compensate for an estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier based on the detected output power and the control signal supplied to the current driver.

26. An automatic power control system according to claim 23, wherein the automatic power control loop further comprises memory means storing characteristics of the semiconductor optical amplifier, the automatic power control loop using the stored characteristics to compensate for the estimated level of amplified spontaneous emission in the output power of the semiconductor optical amplifier.

27. An automatic power control system according to claim 26, wherein the memory means stores a look-up table of the characteristics.

28. An automatic power control system according to claim 26, wherein the memory means stores a numerical formula representing the characteristics.

29. An automatic power control system according to claim 23, wherein the automatic power control loop is arranged to derive an estimated level of the amplified signal from the detected output power, compensating for the level of amplified spontaneous emission in the output power of the semiconductor optical amplifier, and to provide said automatic power control using the estimated level of the amplified signal.

30. An automatic power control system according to claim 29, wherein the automatic power control loop is arranged to derive the error between the estimated level of the amplified signal and the desired level of the amplified signal, and to provide said automatic power control using said error.

31. An automatic power control system according to claim 23, wherein the automatic power control loop comprises a digital controller arranged to provide said automatic power control of the semiconductor optical amplifier using both the detected output power and the desired level of the amplified signal.

32. An automatic power control system according to claim 31, wherein the automatic power control loop includes a current driver arranged to supply said drive current, the automatic power control loop being arranged to control the

current driver to perform said power control by way of the digital controller supplying a control signal to the current driver representative of the drive current.

33. An automatic power control system according to claim 31, wherein the controller is arranged to implement a control algorithm comprising:

estimating the level of the amplified signal in the output power using the detected output power and one of a measure of the drive current or the desired level of the amplified signal; and

calculating the error between the estimated level of the amplified signal and the desired level of the amplified signal.

34. An automatic power controller according to claim 33, wherein

the automatic power control loop includes a current driver arranged to supply said drive current, the automatic power control loop being arranged to control the current driver to perform said power control by way of the digital controller supplying a control signal to the current driver representative of the drive current; and

said step in said control algorithm of estimating the level of the amplified signal in the output power comprises using the control signal supplied to the current driver.

35. An automatic power control system according to claim 23, wherein the optical power detector is a photodetector arranged to receive a portion of the output of the semiconductor optical amplifier.

36. An automatic power control system according to claim 23, wherein the controller further comprises means for outputting monitor signals representing at least one of:

- the output power of the semiconductor optical amplifier;

- the estimated level of the amplified signal; or

- the estimated level of the amplified spontaneous emission in the output power of the semiconductor optical amplifier.

37. A reconfigurable optical add-drop multiplexer for a plurality of frequency channels, comprising:

- a demultiplexer arranged to demultiplex an input multiplexed through channel signal into a plurality of demultiplexed through channel signals in respective frequency channels;

- a plurality of add channels for respective add channel signals in the respective frequency channels;

- in respect of each frequency channel:

- a through channel semiconductor optical amplifier arranged to

amplify the demultiplexed through channel signal in the respective frequency channel,

an add channel semiconductor optical amplifier arranged to amplify the add channel signal in the respective frequency channel, and

a drop channel semiconductor optical amplifier arranged to amplify the demultiplexed through channel signal in the respective frequency channel;

a multiplexer arranged to multiplex into an output signal the outputs of the through channel semiconductor optical amplifier in respect of all the frequency channels together with the outputs of the add channel semiconductor optical amplifiers in respect of all the frequency channels; and

in respect of each semiconductor optical amplifier, an automatic power control system.

38. A method of performing automatic power control of a semiconductor optical amplifier, comprising:

detecting the output power of the semiconductor optical amplifier;

deriving a measure of the drive current to the semiconductor optical amplifier; and

performing power control of the semiconductor optical amplifier using the detected output power and the derived measure of the drive current.

39. A method of performing automatic power control of a semiconductor optical amplifier, comprising:

detecting the output power of the semiconductor optical amplifier;

performing power control of the semiconductor optical amplifier using the detected output power, compensating for the level of amplified spontaneous emission in the output power of the semiconductor optical amplifier.